



Workshop

**Jordan University of Science and
Technology**

13 April 2009



SAND No. 2008-3832C
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration
under contract DE-AC04-94AL85000.





Welcome

- **Workshop purpose**
 - Improve Chemical Safety and Security
 - We learn status and needs in your country
- Overview of schedule
- Contents of binder/CD
- Other announcements
- Introductions





U.S. DEPARTMENT of STATE



The Chemical Security Engagement Program: Improving Best Practices in Chemical Safety and Security

Nancy Jackson, PhD

Manager

International Chemical Threat Reduction Department
Sandia National Laboratories





Why? The Global Chemical Threat

- Prevent disasters, protect the public & workers:

- December, 1984: Bhopal, India

- Deter those that seek to:

- Obtain and use chemical weapons;
 - Recruit scientific experts;
 - Use industrial chemicals as low-cost alternatives to conventional attacks.



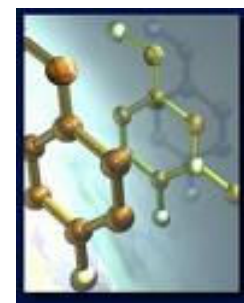


Chemical Security Engagement Program (CSP)



Program Objectives:

- Raise awareness about chemical threat, dual-use nature of chemicals.
- Foster national and regional dialogue.
- Identify chemical safety & security gaps.
- Promote and strengthen scientific collaboration among chemical professionals.
- Provide assistance to improve chemical security and safety best practices.
- **Reduce the chemical threat while promoting beneficial chemical R&D.**





What can be done?

Addressing dual-use can provide dual-benefit:

- Improve occupational health and safety for workers and students.
- Foster dialogue and scientific collaboration among academia and industry worldwide toward peaceful aims.
- Promote safe, secure, sustainable S&T development.





How we do it: Global Chemical Safety & Security Partners

- Work with host countries to assess priorities and gaps in chemical security and safety
- Bring together experts to identify chemical security assistance needs
- Partner with :
 - Host governments
 - International, regional and national professional chemical societies (FACS, IUPAC, etc.)
 - Chemical professionals
 - International efforts to improve chemical safety and security





How CSP will work:



Raise Awareness – Dual use nature of chemicals:

Reducing the chemical threat by collaborating with partner governments and chemical professionals to raise awareness about chemical security and safety, consistent with national and international guidelines, norms and requirements.

Strengthen global scientific cooperation: Providing funding to institutions for projects that advance CSP objectives in chemical safety and security.



Chemical Security Projects in Industry: Working with chemists, chemical engineers and industry representatives in the areas of chemical security and safety, including assistance in risk assessment, safety and security consultations, and design and implementation.

Create training opportunities for scientists, laboratory managers, chemical industry and policy makers on risk/vulnerability assessment and chemical safety to improve chemical security for entities housing, importing or exporting toxic industrial chemicals.





Chemical Security Engagement Program (CSP)



Risks and Gaps Identified:

Universities:

- Lack of safe practices
- Dual use of chemicals
- Improper chemical management
- Improper storage of chemicals
- Lack of enforcement of safety rules/laws

Consequences:

- Injury or death
- Expenses incurred from incidents, spills, disposal
- Loss of trust with community





Chemical Security Engagement Program (CSP)



Risks and Gaps Identified:

Industry:

- Theft of unsecured chemicals
- Improper chemical management
- Improper disposal of chemicals
- Lack of enforcement of safety rules/laws



Consequences:

- Loss of \$\$\$, lower profits, competitor gains
- Injury or death to workers and nearby residents
- Expenses incurred from incidents, spills, disposal
- Loss of trust with community





Chemical Security Engagement Program (CSP)



Course Goal:

- Increase awareness of the importance of chemical safety and security
- Increase knowledge of methods for improving chemical safety and security
- Determine needs for future training/actions

Safety vs. Security:

- Chemical Safety: Protecting people from chemicals
- Chemical Security: Protecting chemicals from people (i.e., terrorists or thieves)

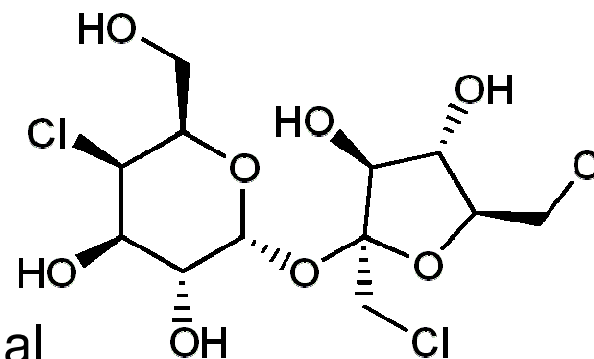




Where CSP will work

Countries with:

- Growing chemistry capabilities
- Growing chemical industry
- Regional security concerns
- Active producers/exporters of industrial chemicals



Regional Approach:

- South and Southeast Asia
- Middle East
- Expanding to other areas





Chemical Security Engagement Program (CSP)

Learn more:

- <http://www.csp-state.net>
- Elizabeth Cameron, PhD
Director, CSP
U.S. Department of State
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Chemical Safety and Security Overview

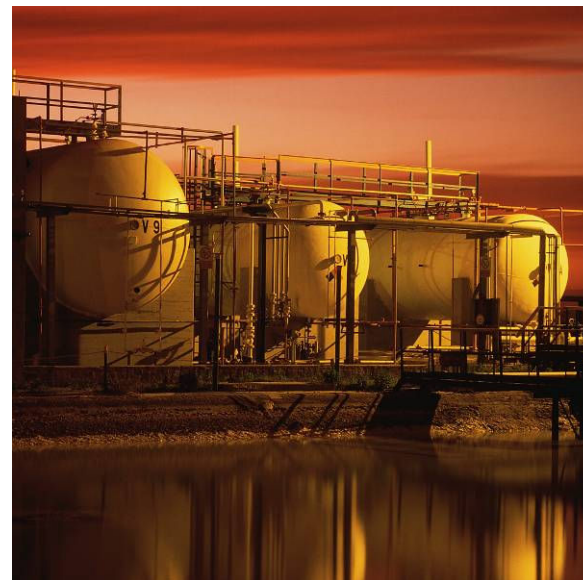
Douglas B. Walters, Ph.D., CSP, CCHO

Environmental & Chemical Safety Educational Institute



Why worry about chemical safety?

- **Chemicals used everyday in labs and factories can be hazardous.**





Bhopal: Pesticide plant chemical release

- One of the greatest chemical disasters in history, December 1984
- Union Carbide plant making Sevin released ~40 tonnes of methyl isocyanate in the middle of the night
- Low local demand for pesticides meant the plant was only partially running
- Some hardware was broken or turned off, including safety equipment
 - Safety measures and equipment far below US standards
- Plant in heavily populated area
- At least 3800 immediate deaths, 500,000 people exposed
 - 15,000-20,000 premature deaths since
- Large area contaminated
- Many issues still not resolved





Taiwan: Silane fire



- **Motech Industries solar cell plant in Tainan Industrial Park**
 - 1 death
 - US \$1.3 million damage
 - Silane / air explosion
 - Operator responded to gas-cabinet alarm
 - Explosion occurred when he opened gas-cabinet
 - Fire burned for 1 hour before being controlled
 - Caused other SiH_4 and NH_3 cylinders to empty
 - November 2005



University of California Santa Cruz: Fire



- Jan. 11, 2002, ~5:30 am, 4th floor of Sinsheimer Lab building, Dept. of Molecular, Cell and Developmental Biology
 - Firefighters responded to alert from heat-detection system in building
 - Controlled by noon
 - Up-to-date inventory of hazardous materials allowed firefighters to enter building and contain fire
 - Building did not have automatic sprinkler system
- Professors and students lost equipment, notes, materials, samples
- Other labs in building closed for weeks to months
 - Water and smoke damage
- Burned labs took 2 years to reopen
- Cause never determined



Dartmouth College: Dimethylmercury poisoning

- Karen Wetterhahn, professor and founding director of Dartmouth's Toxic Metals Research Program
 - expert in the mechanisms of metal toxicity
- In 1996, spilled a few drops of dimethylmercury on her gloved hand
 - Cleaned up spill immediately
 - Latex glove believed protective
- Six months later, became ill and died of acute mercury poisoning at age 48





Cal. State Univ. Northridge: Earthquake

- Magnitude 6.7, Jan. 17, 1994, 4:31 am
- 57 deaths, 11000 injuries
- Epicenter a few km from California State University Northridge campus

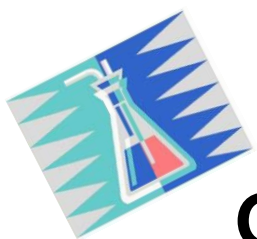


- Several fires in science buildings.
 - Allowed to burn because firemen worried about chemical hazards
- Professors and students lost equipment, notes, materials, samples



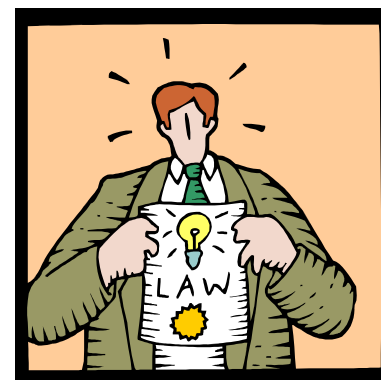
Why worry about chemical safety?

- **Health and safety of scientists**
- **Community relationships**
 - Loss of trust can interfere with how you operate your lab facility
- **Environment**
 - People want clean air, safe food and water
- **Reduce chance of accidental chemical release**
 - Normal operations
 - Abnormal conditions such as earthquakes
- **Avoid loss and damage to labs and equipment**
- **Be safe while doing good science**



Government regulations: Chemical safety

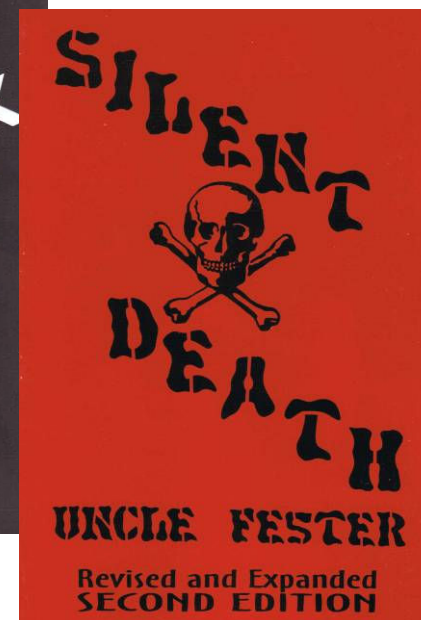
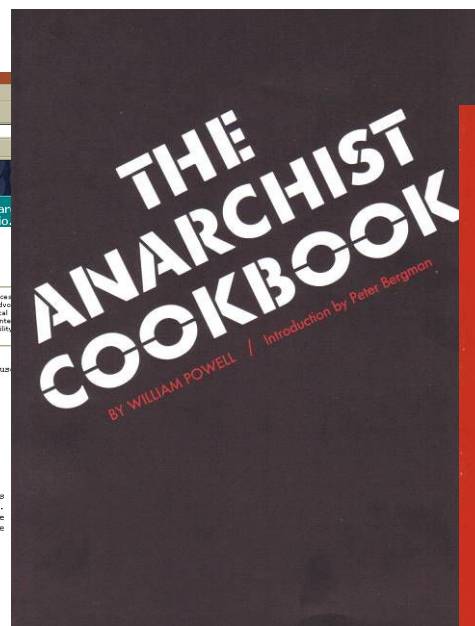
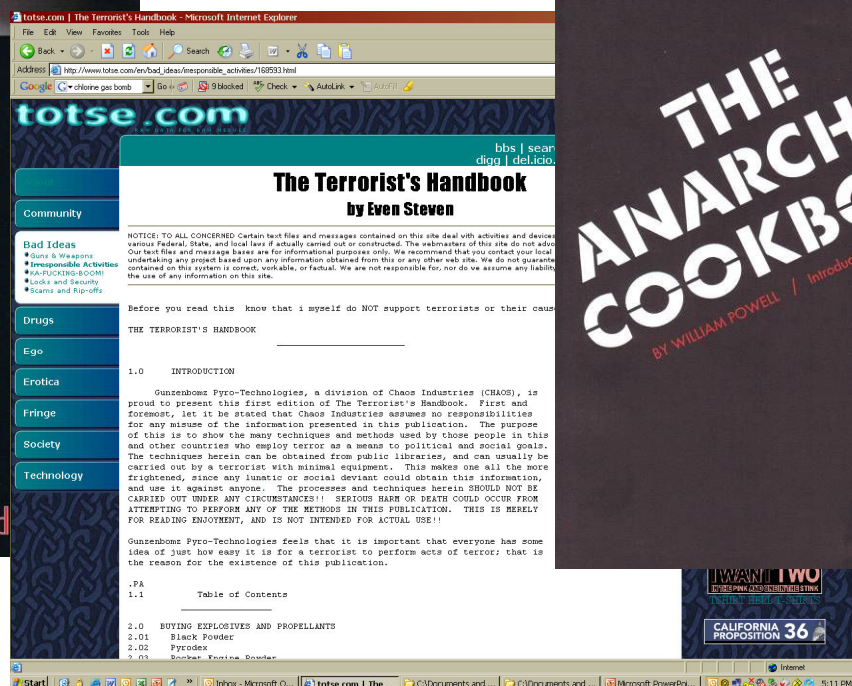
- Will be different from country to country
- US examples:
 - OSHA (Occupational Safety and Health Act)
 - RCRA (Resource Conservation and Recovery Act)
 - TSCA (Toxic Substances Control Act)
 - CAA (Clean Air Act)
 - NEPA (National Environmental Policy Act)
 - Various State-specific regulations
- European Union: REACH
- Your country ?





Why worry about chemical security?

- Long history of people deliberately using chemicals to harm others.
- Information on how to acquire and deliver them is easy to get.





Aum Shinrikyo: Matsumoto and Tokyo, Japan



Photo of wanted poster from Wikipedia commons

- Sarin attack on Judges in Matsumoto, June 1994
 - Sarin sprayed from truck at night
 - 7 deaths, 144 injuries
- Sarin attack on Tokyo subway, March 1995
 - 11 bags with 600 g each on 3 main subway lines
 - 12 deaths, 3938 injuries
- Hydrogen cyanide attacks on Tokyo subway, May 1995
 - Bags of NaCN and sulfuric acid
 - No deaths, 4 injuries
- Recruited young scientists from top Japanese universities
- Produced sarin, tabun, soman, VX
- Purchased tons of chemicals through cult-owned companies
- Motives: proof of religious prophecy, kill opponents, interfere with legal proceedings and police investigations



Chicago, Illinois, USA

- **March 2002, an anarchist (called himself “Dr. Chaos”) was found at 2 am in a Univ. Illinois, Chicago, building carrying sodium cyanide**
- **Had chemicals in a storage room at the Chicago subway**
 - **included containers marked mercuric sulfate, sodium cyanide, potassium cyanide, and potassium chlorate**
 - **0.25 pound of potassium cyanide and 0.9 pound of sodium cyanide**
 - **stolen from an abandoned warehouse, owned by a Chicago-based chemical company**
 - **15 drums and 300 jars of various other laboratory chemicals were discovered there**



- **Sentenced to prison for “possessing a chemical weapon”, as well as other charges (Interfering with power, air-traffic control systems, computer systems, broadcast systems and setting fires).**

<http://cns.miiis.edu/db/wmdt/incidents/1190.htm>,
accessed 12/07



Iraq



- **Many incidents in which chlorine gas cylinders are blown up with explosives**
 - Chlorine probably stolen/diverted from water purification plants or oil industry
 - Many civilians and non-combatants injured
- **Chlorine first used in WWI as a chemical weapon**

On March 23, 2007, police in Ramadi's Jazeera district seized a truck filled with "five 1000-gallon barrels filled with chlorine and more than two tons of explosives"

From http://www.longwarjournal.org/archives/2007/03/al_qaedas_chlorine_w.php downloaded Jan 2008.



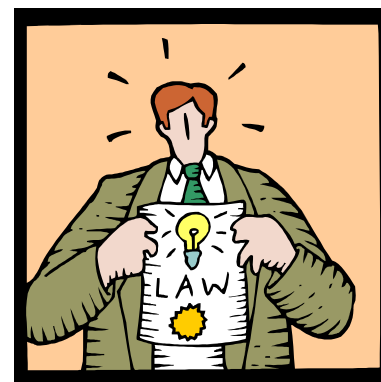
Why worry about chemical security?

- Health and safety of people and environment
- Community relationships
- Reduce chance of accidental chemical release
- Avoid loss and damage to labs and equipment
- Prevent criminals and terrorists from getting dangerous chemicals
 - Wide variety of chemicals have been used
 - Wide variety of motivations for actions
- A deliberate attack on a chemical facility could release a large amount of hazardous chemicals
 - Injure or kill people in nearby areas
 - Eliminate jobs and economic assets



Government regulations: Chemical security

- Will be different from country to country
- Legislation needed to fulfill requirements under the Chemical Weapons Convention
 - Each country passes appropriate laws
 - Each country must declare and track certain chemicals
- UN Resolution 1540
- Other export control legislation





Laboratory Chemical Safety: Concepts of Anticipation, Recognition, Evaluation and Control

Douglas B. Walters, Ph.D., CSP, CCHO

Environmental & Chemical Safety Educational Institute



Fundamentals of Laboratory Chemical Safety



References



“Safety in Academic Laboratories, Vol.1 & 2,” American Chemical Society, Washington DC, 2003, handouts and available online:

<http://membership.acs.org/c/ccs/publications.htm>

“Prudent Practices in the Laboratory: Handling and Disposal of Chemicals,” National Academy Press, 1995, available online:

http://www.nap.edu/catalog.php?record_id=4911

“Hazardous Chemicals: Control and Regulation in the European Market,” H.F.Bender and P. Eisenbarth, Wiley-VCH, Weinheim Germany, 2007



Purpose of Laboratory Chemical Safety

- **Protect the worker**
- **Safeguard the environment**
- **Comply with regulations**
- **Support the conduct of the studies**





Laboratory Chemical Safety

Safety---freedom from danger, injury, or property damage

Hazard---the potential to harm



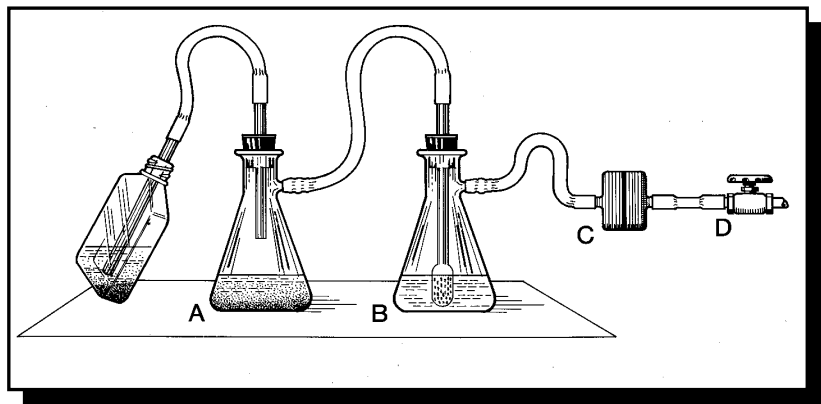
We want to avoid this.

Risk---the probability that harm will result



Laboratory Chemical Safety

Are all agents dangerous?



or



Is it their *improper* use that makes them dangerous?



Degree of hazard depends on

- **Chemical / physical properties**
- **Route of entry**
- **Dosage or airborne concentration**
- **Exposure duration or frequency**
- **Environmental conditions**
- **Controls**



Chemical Laboratory Hazards

- **Chemical hazards**

dusts, fumes, mists, vapors, gases

- **Physical hazards**

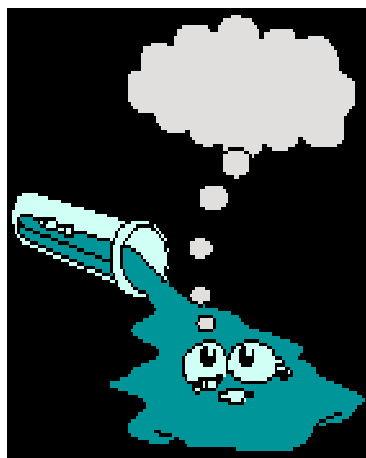
fire, electrical, radiation, pressure vibration, temperatures, noise,

- **Ergonomic hazards**

repetitive motion (pipetting), lifting, work areas (computers, instruments)

- **Biological hazards**

pathogens, blood or body fluids





Chemical Laboratory Safety

Based on Industrial Hygiene Principles

- **Anticipation**
 - **Recognition**
 - **Evaluation**
 - **Control**
- chemical hazards
physical hazards
ergonomic hazards
biological hazards



Anticipate

- **Potential problems and concerns**



- **Design a safe experiment first—
–Don't just design an experiment!**



Anticipation

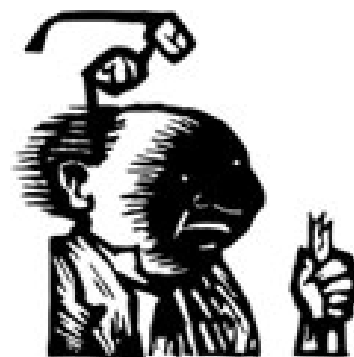
- **Plan Experiment in Advance**
 - Outline proposed experiment
 - What chemicals? How much?
 - What equipment?
 - Acquire safety information
 - MSDS (Material Safety Data Sheet)
 - REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals)
 - ICSCs (International Chemical Safety Cards)
 - Reference textbooks
 - Consult with Safety Office?





Hazard Recognition & Evaluation

- **What are the anticipated risks?**
 - **Are the equipment & facilities adequate?**
 - Is special equipment needed?
 - **Are staff properly and sufficiently trained?**
 - Who will do the experiment?
 - What kind of training do they need?
 - **Can the experiment go wrong?**
 - What would go wrong?
 - Is there a plan for this?





Hazard Evaluation

- **What are the potential or actual agents/exposures?**
- **When and where does the exposure occur?**
- **Which workers are exposed and how does the exposure occur?**
- **What is the evidence of exposure?**
- **What control measures are present, available, and effective?**



Control

- **How are the risks controlled?**



- **Administrative controls**
- **Engineering controls**
 - enclosure / isolation
 - ventilation / hoods
- **Personal Protective Equipment (PPE)**
- **Emergency Plan**



Control Objectives

☐ Maximize Containment

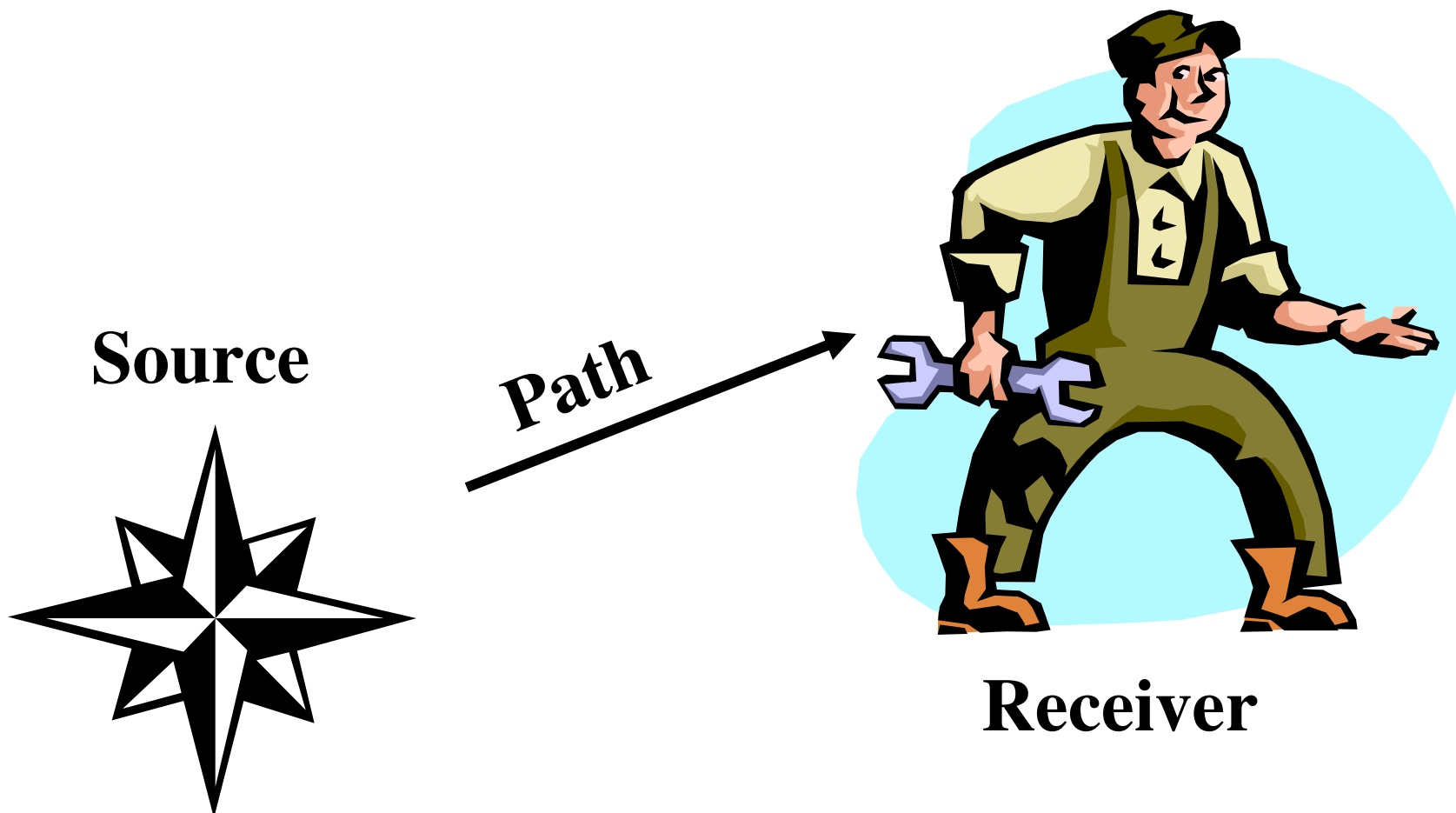


☐ Minimize Contamination

☐ *Redundancy is the Key*



Exposure Control





Recognition

☐ Types of lab hazards

Chemical toxicity

Fire / explosion

Physical hazards

Biohazards

Radiation

Special substances





Types of Hazards in Chemical Laboratories

Douglas B. Walters, Ph.D., CSP, CCHO

Environmental & Chemical Safety Educational Institute



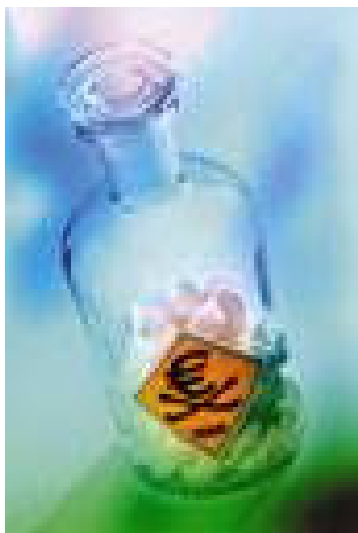
Chemical Toxicity

Acute (short term, poisons, asthmagens)

**cyanide
strychnine**

Chronic (long term, carcinogens, reproductive)

**vinyl chloride (liver cancer)
asbestos (mesothelioma, lung cancer)
thalidomide (developmental birth defects)**





Chemical Toxicity

- Toxicity depends on
 - concentration (dose)
 - frequency
 - duration
 - route of exposure



“Dose makes the poison.
All substances have the
potential to harm.”
Paracelsus ~1500 AD



300 mg aspirin = safe

3000 mg aspirin = toxic



Particularly Hazardous Substances

☐ Chemical Carcinogens

☐ Reproductive & Developmental Toxins

☐ Highly Toxic Chemicals



Routes of Exposure

Inhalation*

Breathing Zone

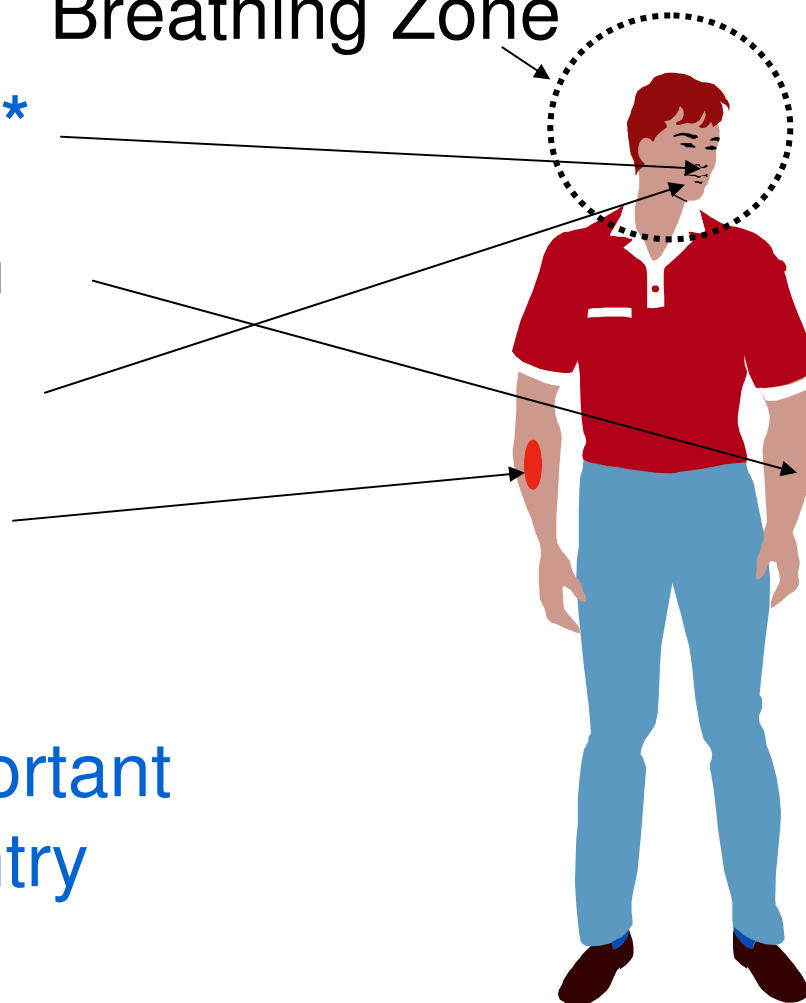
Eyes

Absorption

Ingestion

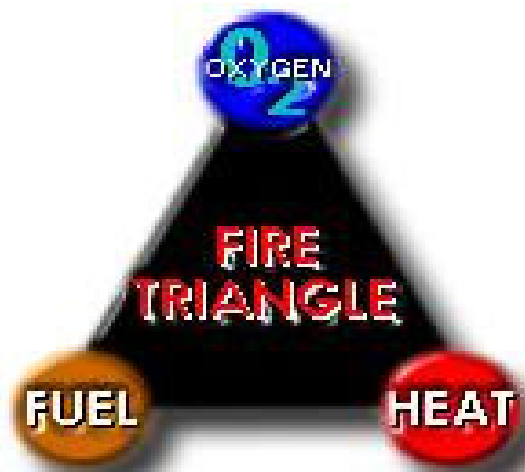
Injection

***Most important
route of entry**





Fire and Explosion Hazards



- Flammable solvents
- Pyrophorics
- Spontaneous combustion





Physical and Ergonomic Hazards

- Moving unguarded parts, pinches
 - vacuum pump belts
- Broken glassware and sharps, cuts
- Pressure apparatus
- Vacuum containers
- Dewar flasks
- Cryogenics
- High voltage equipment
- Computer workstations
- Slips, trips & falls

BE CAREFUL

**THIS MACHINE
HAS NO BRAIN
USE YOUR OWN**





BioHazards

☐ Blood borne pathogens

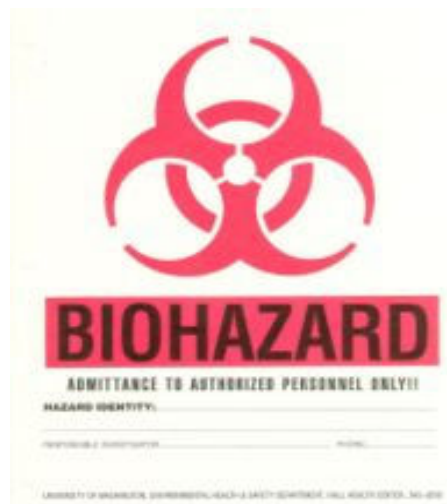
AIDS, HIV, Hepatitis, clinical chemistry labs

☐ Recombinant DNA

Genetic engineering, cloning

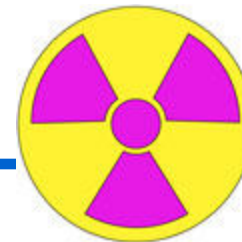
☐ Work with animals

Zoonosis, diseases from animals





Radiation Hazards



- **Ionizing Radiation**

alpha , beta , gamma , X-rays, neutrons

- **Radioactive isotopes**

tritium (H-3), carbon (C-14), sulfur (S-35),
phosphorus (P-32/33), iodine (I-135)





Radiation Hazards



☐ *Non-Ionizing Radiation*

Ultraviolet (UV spectrometers)

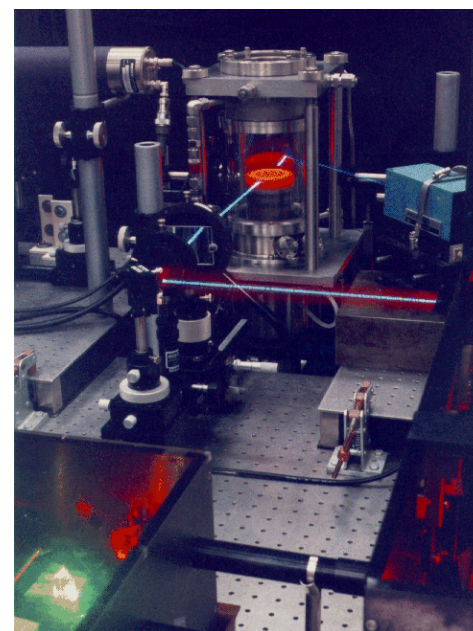
Magnetic (NMR, MRI)

Microwave

(Heart pacemaker hazard)

Lasers

(eye protection required)





Special Chemical Substances

☐ Controlled Substances

regulated drugs, psychotropic (hallucinogenic) substances, heroin



☐ Chemical Surety (Warfare) Agents

nerve gas, phosgene, riot control agents





Chemical Lab Safety: Administrative, Operational, and Engineering Controls

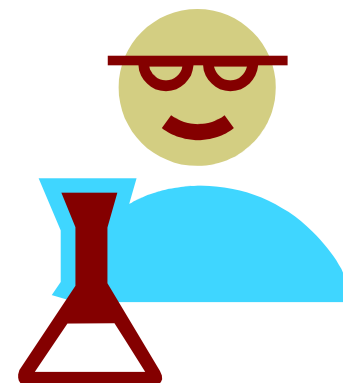
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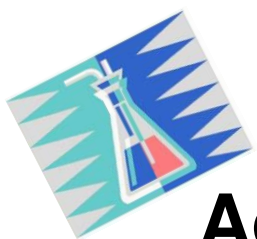
Environmental & Chemical Safety Educational Institute



Evaluation & Control

- ☐ **Administrative practices**
organizational policies
- ☐ **Operational practices**
work practices
- ☐ **Engineering controls**
Hardware (ventilation,
barriers)

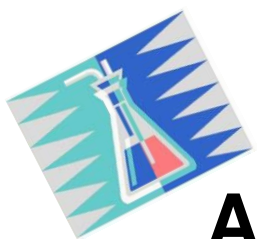




Administrative Practices: Lab Safety Policies

- ❖ **Have organizational safety practices**
 - **Apply to everybody**
 - **Don't work alone after hours**
 - **Specify when eye protection & PPE is required**
 - **Specify operations that require hood use**
 - **No eating in labs**
 - **No mouth pipetting**
 - **No loose long hair or dangling attire**
 - **Label all chemical containers**
- ❖ **Have a Safety Manual**





Administrative Practices: Lab Safety Policies

- Schedule routine, periodic maintenance and inspection of fume hoods
- Schedule routine, periodic maintenance of safety showers and eye wash stations
- Schedule routine, periodic maintenance of fire suppression/fighting equipment
- Post restricted areas with proper signs
 - radiation, biosafety, carcinogen, high voltage, lasers, authorized personnel only, etc.





Operational Practices: Safe Laboratory Procedures



- **Use hoods properly**
 - 6” in from sash
 - in center of hood
 - work with hood sash at 12-18”
 - close sash when not in use
 - don’t use for storage



Operational Practices: Safe Laboratory Procedures

❖ Safely transport chemicals

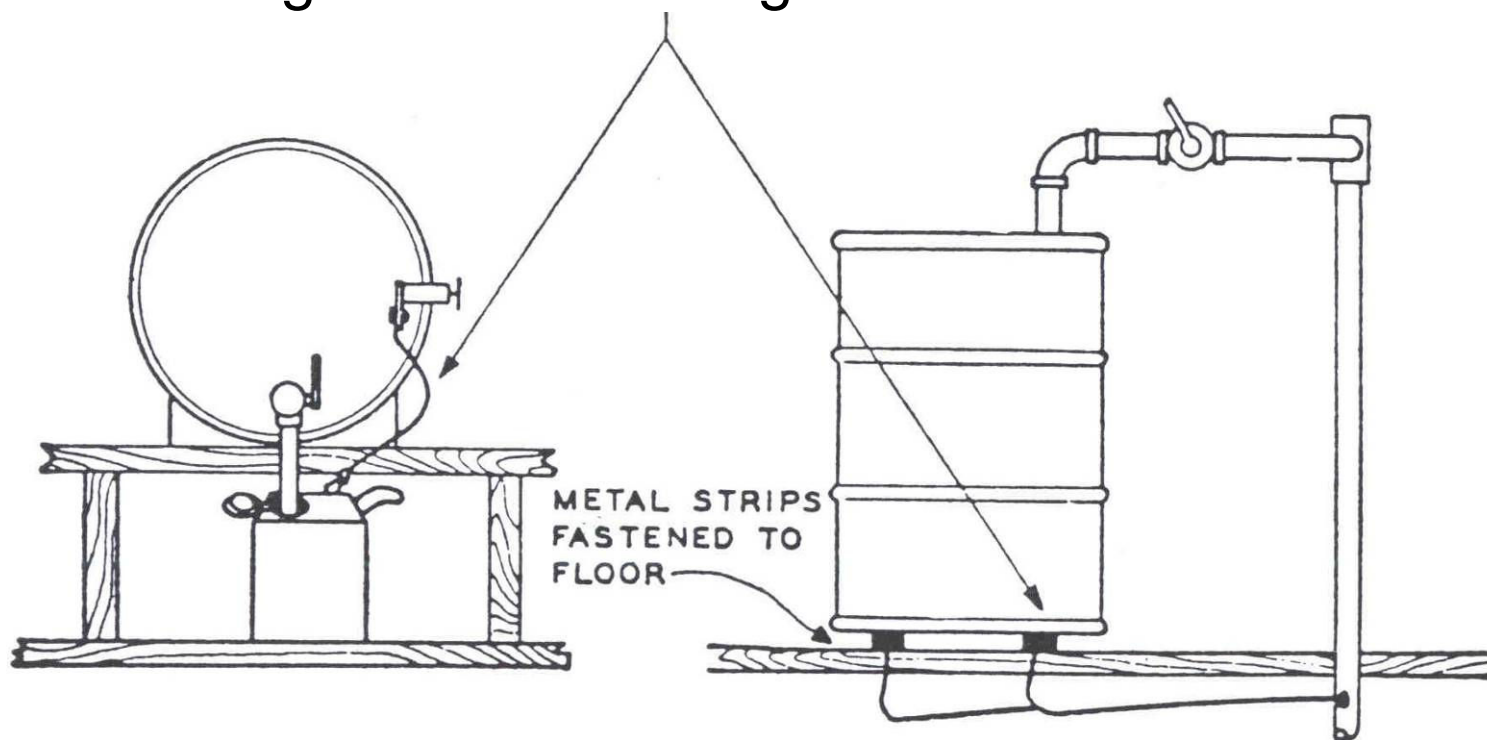
- use container in a container concept
 - label all containers
 - inform driver of hazards
- provide contact names, phone numbers
 - provide MSDS





Operational Practices: Control of Static

Wire needed unless containers are already bonded together, or fill stem is always in metallic contact with receiving container during transfer





Operational Practices: Safe Laboratory Procedures



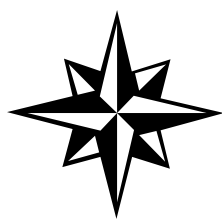
❖ Housekeeping

- label all containers
- clean-up spills
- eliminate trip hazards
- proper storage



Engineering Controls: Laboratory Containment Principles

Concept



Source



Path



Receiver



Control Used

**Engineering
Control**



**Operational
Practices**



PPE



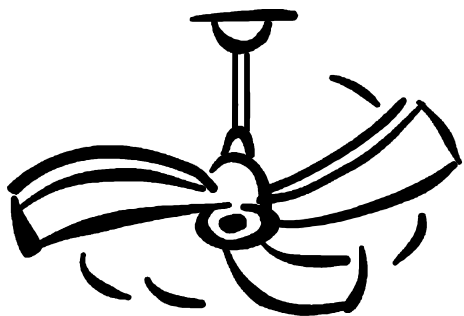
Engineering Controls

- 1. Change the process**
eliminate the hazard
- 2. Substitution**
use non-hazardous substance instead of hazardous, such as toluene for benzene
- 3. Isolate or enclose the process or worker**
use a barrier
- 4. Ventilation**
dilution (general ventilation) - not good
local exhaust ventilation (LEV) - Preferred





Engineering Controls



Dilution / general ventilation
not good

Local exhaust ventilation
Preferred





Engineering Controls

Laboratory hoods and ventilation are the basis of engineering controls.

But they must be properly: **functioning**, **maintained** and **used**!





Engineering Controls: Local exhaust

Local exhaust ventilation options include:

Snorkels



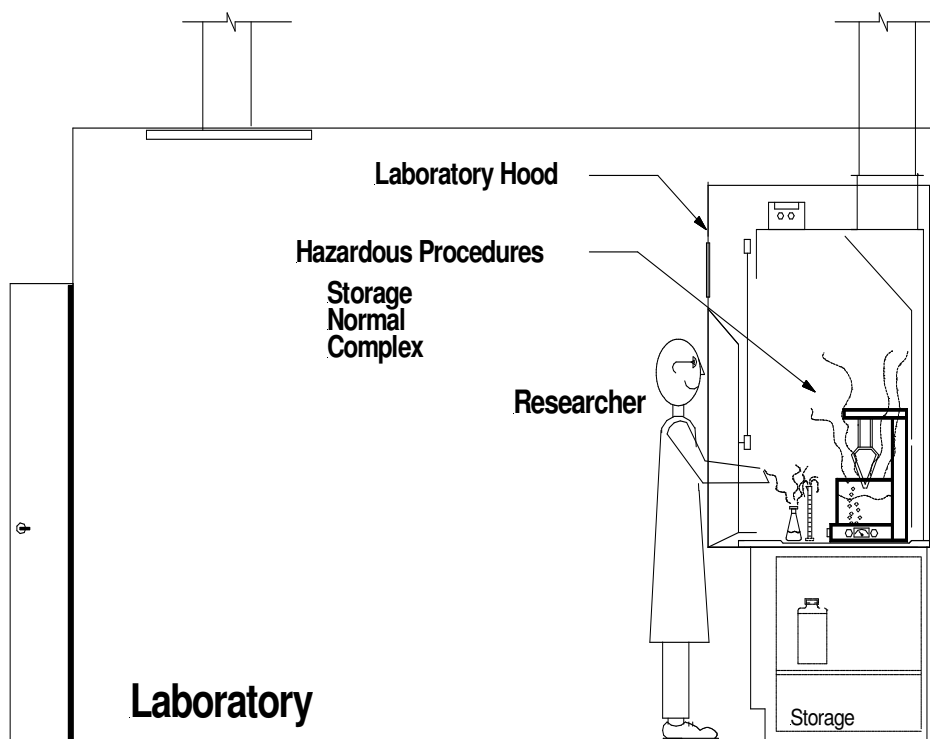
Vented enclosures





Proper Hood Use

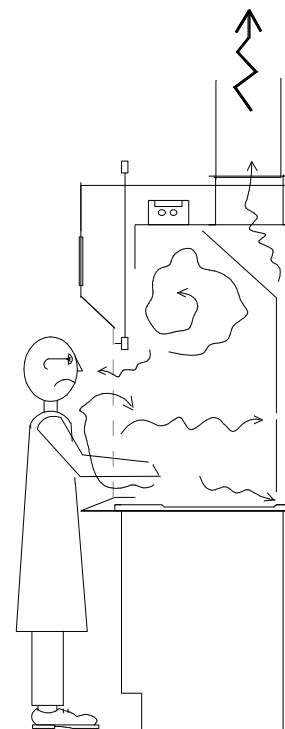
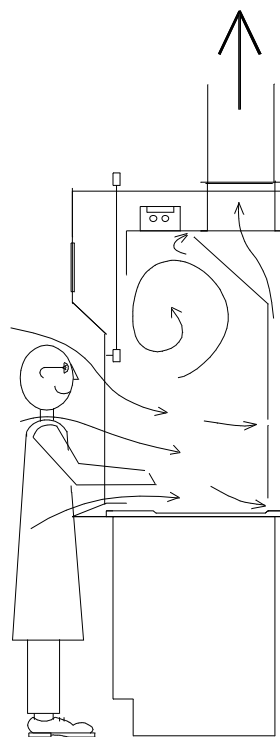
- **Locate hood away from potential cross drafts**
 - Diffusers, doors, windows, traffic
- **Check hood is working properly before starting**
- **Check for containment**
- **Avoid clutter**
- **Do not use for storage**
- **Sash height at 12-18 “**
- **Work 6” in from sash**
 - and in center





Hood Containment

- Smoke candles and tubes can evaluate hoods





Engineering Controls: Exhaust vents

Hood exhaust should not be blocked or deflected downward, but should exhaust straight up





Engineering Controls: Exhaust vents

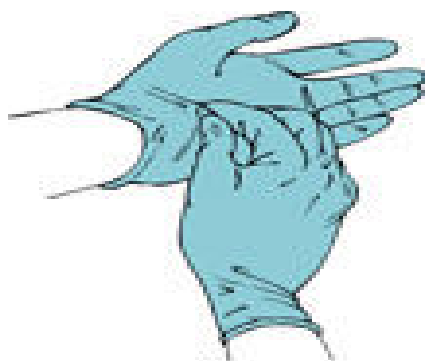


**Avoid exhaust
re-entrainment**

**Disperse
emissions
straight upward
and downwind!**



Engineering Controls: Personal Protective Equipment (PPE)



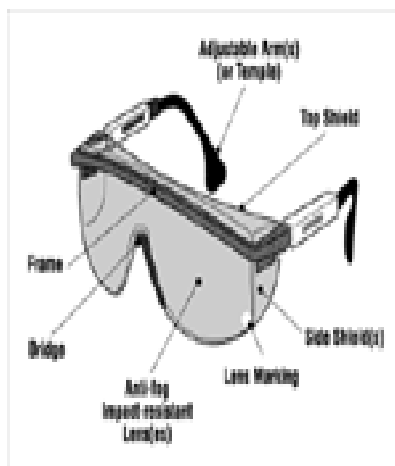
**PPE includes:
eye protection,
gloves,
laboratory coats. etc.,
respirators,
appropriate foot protection**





Engineering Controls: Personal Protective Equipment

Eye protection specific to the hazard





Engineering Controls: Personal Protective Equipment

Gloves

must be chemical specific





Engineering Controls: Foot Protection

Safety shoes with steel toes are not necessary for laboratory work unless there is a serious risk from transporting or handling heavy objects.



**however,
open toe shoes
should NOT be worn in labs**



Breakout Discussion

- **Current Status of Chemical Safety and Security**
- **30 minutes**
- **Summarize on Worksheets**





Emergency Planning and Response

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Environmental & Chemical Safety Educational Institute



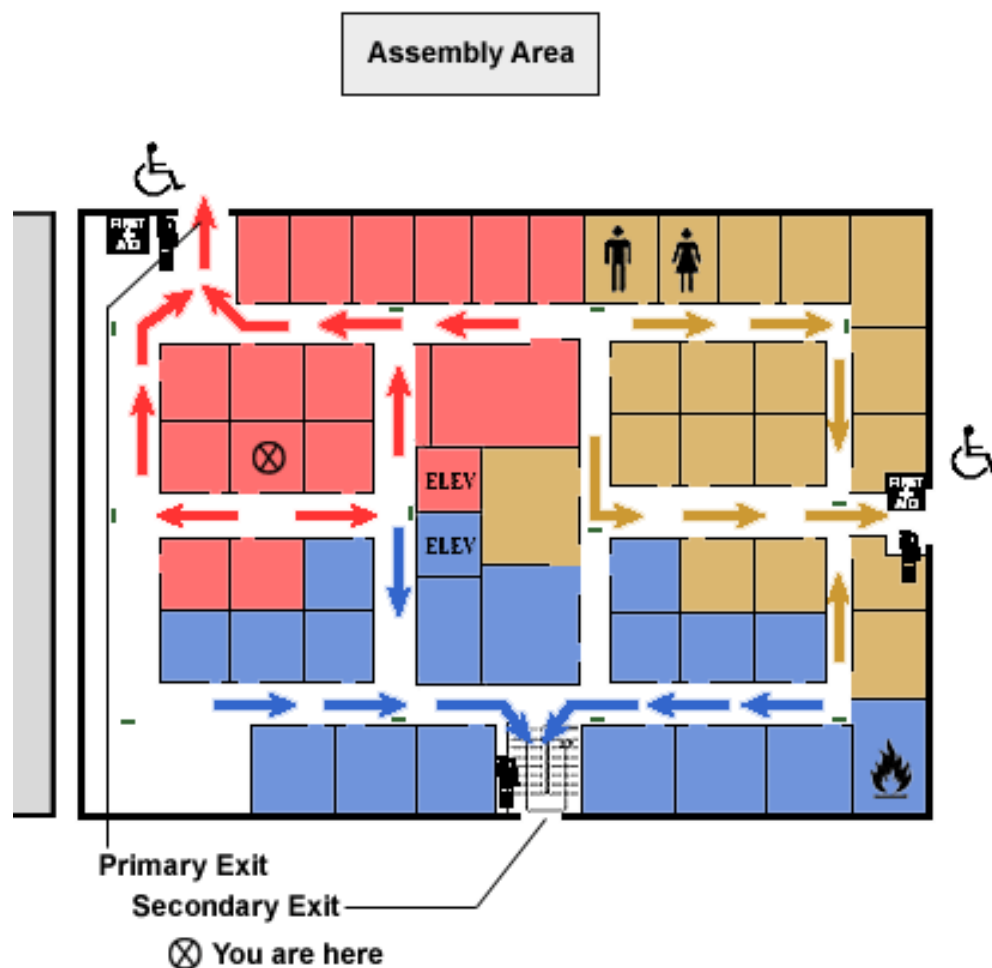
Emergency planning and response is based on safety principles of

- Anticipation
- Recognition
- Evaluation
- Control



Emergency Planning & Response

**Have an
evacuation
plan
and
POST IT**





Emergency Planning & Response

**Don't use hallways
for storage**

Dangerous!!

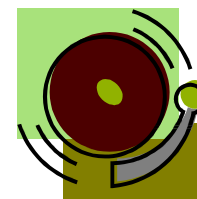
**Blocks passage and
emergency exit
path**





Emergency Planning & Response

- Have routine, unannounced evacuation drills
- Test and maintain alarms
- Designate person for each area to ensure bathrooms, etc. are evacuated

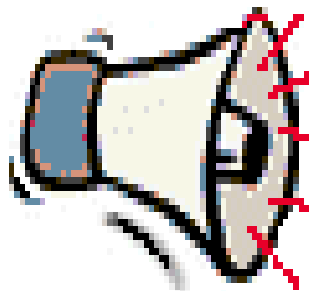


- Locate outside staging areas sufficient distance from building
- Designate person to meet/direct emergency vehicles



Emergency Planning & Response

Alarm systems need to be properly located, maintained, and serviced regularly





Emergency Planning & Response

Centrally locate and maintain fire extinguishers and alarms





Emergency Planning & Response

If people are expected to use extinguishers
they must be trained





Emergency Planning & Response

Post each room with:

- **Emergency phone numbers**
- **After hour phone numbers**
- **Person(s) to be contacted**
- **Alternate person(s)**
- **Unique procedures to be followed**

Location	
Hazards Within:	
Primary Contact:	
Second Contact:	
Building Monitor/Safety:	
Department Head:	
Fire/Police/Ambulance:	911
Envir. Health & Safety (or RSO, if needed):	646-3327



Emergency Planning & Response

**Label and keep all exits clear,
unlocked or equipped with panic bars**





Chemical Exposures to Eyes or Skin

Centrally locate safety showers and eyewashes

- Remove contaminated clothing
- Thoroughly flush with water
- Follow chemical specific procedures (i.e.. HF)
- Seek medical assistance





Chemical Spills

Centrally locate spill clean-up kits

Clean up spill only if you know the chemical hazards, have appropriate equipment and are trained to do so!

- alert colleagues and secure area
- assess ability to clean-up spill
- find spill kit
- use appropriate PPE and sorbent material
- protect sinks and floor drains
- clean-up spill, collect/label waste for disposal
- report all spills





Safe/Secure Transport of Chemicals

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International transport references

UNECE, “Globally Harmonized System Of Classification and Labeling of Chemicals (GHS),” 1st edition, 2003, online,

http://www.unece.org/trans/danger/publi/ghs/ghs_rev00/00files_e.html

International Airlines Transportation Association, Dangerous Goods Regulations(DGR), 2008, not online,

<http://www.iata.org/ps/publications/9065.htm>

UN International Maritime Organization (IMO),

<http://www.imo.org/>

European Union (EU) Transport Activities

<http://europa.eu/>

US Department of Transportation (DOT)

<http://www.dot.gov>



International Shipping Fines

- For international shipments fines are severe
 - up \$250,000 fine + 5 years prison in US
- Apply to scientists improperly transporting
 - samples
 - test material
 - specimens
- Dangerous Goods Regulations are set by:
 - IATA: International Air Transport Association





What is a hazardous chemical shipment?

- Corrosives
- Dry Ice
- Explosives
- Flammables
- Gases
- Flammable liquids
- Flammable solids
- Genetically modified organisms
- Infectious substances
- Magnetized material
- Oxidizing substances
- Radioactive substances
- Toxic substances
- Aerosols



Forms of transport

Outside of facility:

- air
- ship
- rail
- road



Within a facility:

- vehicle (car / truck)
- cart
- hand carry





Always know

- Who transports the material?
- How is it transported?
- How is it packaged?
- Are transporters knowledgeable and prepared?
- Is there safety documentation?
- When did it leave, arrival time?
- Verify departure and arrival





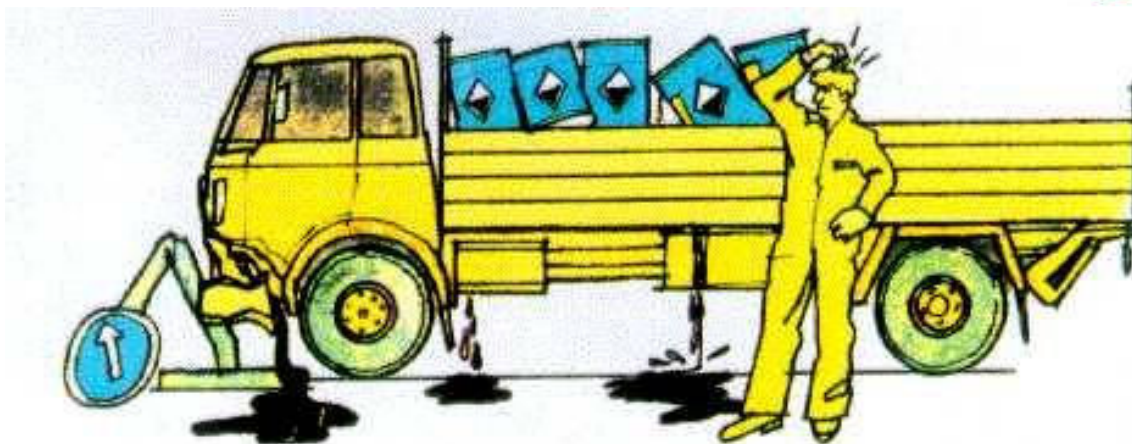
Always expect the unexpected





Take Precautions

- Proper Packaging
- Spill and leakage protection



Small spills from many cars daily; when counted together make...



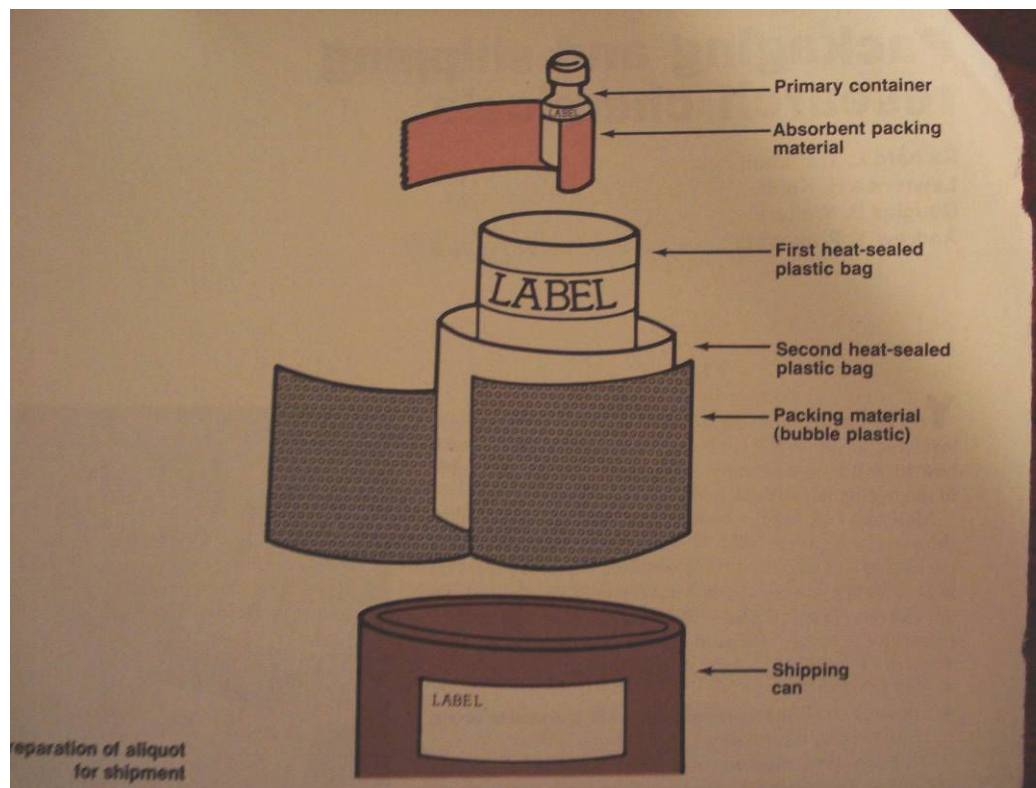
Special shipping requirements?

- What are the physical and chemical properties?
- Is dry ice or refrigeration necessary?
- Are specific containers required?
size, strength, composition



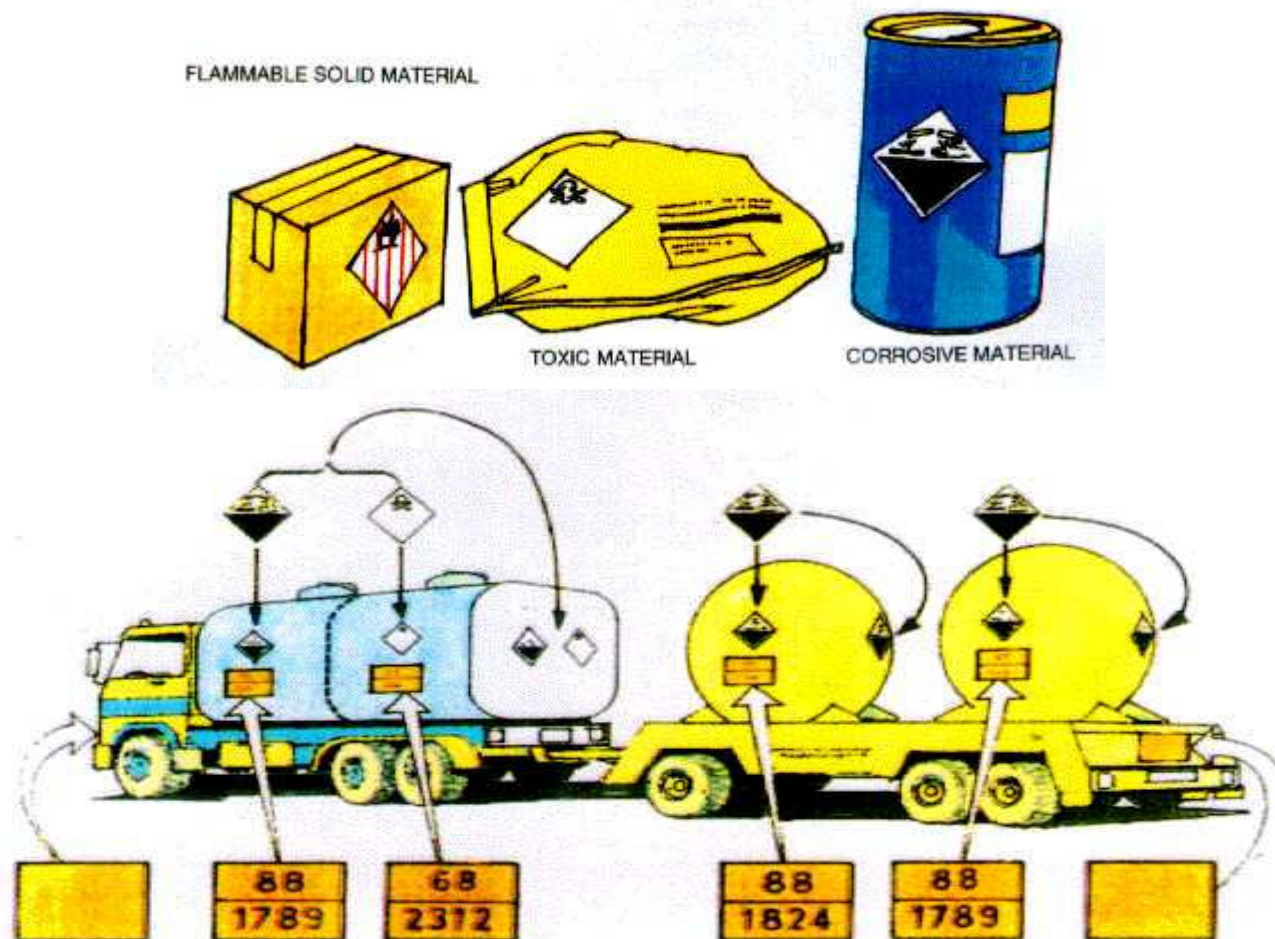


Container within a container concept





Labels and Placards





-
- A photograph of a storage area. In the foreground, there are several white plastic buckets, some stacked. Two of the buckets have red diamond-shaped hazard labels with a flame symbol and the text 'FLAMMABLE LIQUID'. To the left, there is a cardboard box with a yellow diamond-shaped hazard label with a flame symbol and the text 'FLAMMABLE LIQUID'. In the background, there are more boxes and a sign on the wall that reads 'Flammable Hazardous' and 'Injury: Do Not Breathe Over Two (2) Feet'.



Documentation

- Shipping Order
- Bill of lading
- Manifest
- Full addresses for Shipper and Receiver
- Packing and Labeling Certification
- Verification of Receipt
- *Safety Data Sheets*
- Follow-up documentation
- Require incident/accident reports



FLINN SCIENTIFIC INC.

"Your Safer Source for Science Supplies"

Material Safety Data Sheet (MSDS)

MSDS #: 5.00

Revision Date: September 24, 2002

Section 1 — Chemical Product and Company Identification

Acetic Acid; Glacial

Flinn Scientific, Inc. P.O. Box 219 Batavia, IL 60510 (800) 452-1261
CHEMTREC Emergency Phone Number: (800) 424-9300

Section 2 — Composition, Information on Ingredients

Acetic Acid; Glacial
Synonyms: vinegar acid, ethanoic acid
CAS#: 64-19-7

Section 3 — Hazards Identification

Clear colorless liquid, strong vinegar odor.
Corrosive, causes severe burns to eyes and skin. Moderately toxic by ingestion, inhalation and skin absorption. Fumes can be suffocating.
Class II Combustible Liquid.

FLINN AT-A-GLANCE
Health-2
Flammability-2
Reactivity-2
Exposure-3
Storage-3
0 is low hazard, 3 is high hazard

Section 4 — First Aid Measures

Call a physician, seek medical attention for further treatment, observation and support after first aid.
Inhalation: Remove to fresh air at once. If breathing has stopped give artificial respiration immediately.
Eye: Immediately flush with fresh water for 15 minutes.
External: Wash continuously with fresh water and mild liquid soap for 15 minutes.
Internal: Give 1 to 2 cups of water or milk, followed by a gastric antacid, such as milk of magnesia. Do not induce vomiting. Call a physician or poison control at once.

Section 5 — Fire Fighting Measures

Class II Combustible liquid. When heating to decomposition, emits irritating fumes.

Flash Point: 103 F (OC) Upper: 19.9% Lower: 4.0% Ait: 867 F

Fire Fighting Instructions: Use triclass, dry chemical fire extinguisher. Firefighters should wear PPE and SCBA with full facepiece operated in positive pressure mode.

NFPA CODE
H-3
F-2
R-0

Section 6 — Accidental Release Measures

Restrict unprotected personnel from area. Remove all ignition sources and ventilate area. Contain spill with sand and absorbent material, neutralize with sodium bicarbonate or calcium hydroxide and deposit in sealed bag or container. See Sections 8 and 13 for further information.

Section 7 — Handling and Storage

Flinn suggested chemical storage pattern: Organic #1. Store with acids, anhydrides and peracids. Store away from Nitric Acid. Store in a dedicated acid cabinet and away from any source of water; if an acid cabinet is not available, store in a Flinn Saf-Cube. Use and dispense in a hood.

Section 8 — Exposure Controls, Personal Protection

Avoid contact with eyes, skin and clothing. Wear chemical splash goggles, chemical-resistant gloves and chemical-resistant apron. Use ventilation to keep airborne concentrations below exposure limits. Always wear a NIOSH-approved respirator with proper cartridges or a positive pressure, air-supplied respirator when handling this material in emergency situations (spill or fire).
Exposure guidelines: TWA 10 ppm, STEL 15 ppm (OSHA, NIOSH)

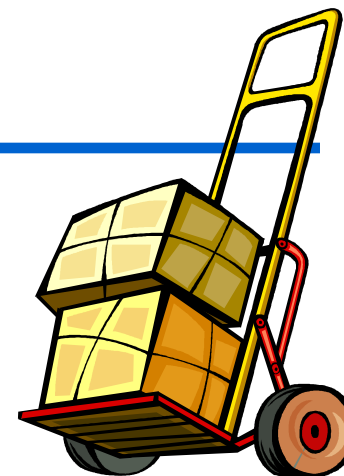
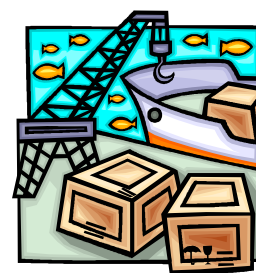
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Handling

- Where, how, who – packs the shipment?
- Is there special equipment needed to load and unload a shipment?
- Where, how, who – opens the shipment?
- Should package be opened in a hood?
- Is the material radioactive?
- Is monitoring equipment needed?
- Is special storage needed on receipt?





Who requires training?

- **Managers**
- **Packers**
- **Handlers**
- ***Loaders***
- ***Drivers***
- **All shipping and receiving personnel**
- **Mailroom personnel**





Emergency Preparation

- **Transportation accidents/incidents:**

- Organization reports
- Police reports
- Emergency contacts

- **Spill and leakage control:**

- prevention
- minimization
- spill clean up kits
- PPE



Who is responsible of damages if a leaking drum spills dangerous material? You?



Plan ahead

- Have a plan
- Remember:
 - Anticipation
 - Recognition
 - Evaluation
 - Control



Safety equipment should have a routine check.



Acknowledgment

International Labour Organization (ILO)

**International Occupational Safety and Health
Centre (CIS)**

**Programme on Safety and Health at Work and the
Environment (SafeWork)**

<http://www.ilo.org/public/english/protection/safework/cis/index.htm>